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*RPSE*

# **SHUTTLE OPERATIONS ZERO BASE COST STUDY**

## **PRESENTATION TO DR. LENOIR JULY 2, 1991**

# ZERO BASE OPERATIONS COST STUDY

## PROJECT REPRESENTATIVES

### ORGANIZATION

LAUNCH AND LANDING  
LOGISTICS  
PAYLOAD PROCESSING  
ENGINEERING  
FLIGHT CREW OPERATIONS  
MISSION OPERATIONS  
ORBITER  
SPACE & LIFE SCIENCES  
SSPO  
    ENGINEERING INTEGRATION  
    INTEGRATION & OPERATIONS  
    MANAGEMENT INTEGRATION  
ET  
PROPULSION SYSTEMS INTEGRATION  
RSRM  
SRB  
SSME

### REPRESENTATIVE

ROY THARPE/WAYNE TREAT  
ROY THARPE/ANNE GAWRONSKI  
ELLIOT ZIMMERMAN  
WARREN BRASHER/JON HALL  
DAVE LEESTMA/CAROL LATTIER  
PAUL DELL'OSSO/JACK PETERSEN  
RALPH SCHOMBURG  
DON ROBBINS/RALPH ALBON  
  
MAC JONES/JESSE CONTRERAS  
RON LENTZ  
DAVE SCHULTZ  
JODY ADAMS  
LINDA POSEY  
SANDY COLEMAN  
JACK HOUSLEY  
MIKE ALLEN

# ZERO BASE OPERATIONS COST STUDY

- INITIAL OBJECTIVES DEFINED BY LETTER FROM CAPT. CRIPPEN DATED 1-17-91
  - ESTABLISH THE REQUIREMENTS FOR A MINIMUM FLIGHT RATE CAPABILITY (I.E., WHAT IS REQUIRED TO FLY ONE FLIGHT PER YEAR)
  - IDENTIFY THE INCREMENTAL INCREASES ABOVE THE MINIMUM CAPABILITY TO ACHIEVE THE 10 FLIGHTS PER YEAR MAXIMUM RATE REFLECTED IN THE LATEST MANIFEST
- OBJECTIVES AUGMENTED BY LETTER FROM DR. LENOIR DATED 3-19-91
  - COMPREHENSIVE "BOTTOMS-UP" ASSESSMENT OF COSTS TO OPERATE THE SPACE SHUTTLE
    - ADDRESS ALL ASPECTS OF THE PROGRAM, INCLUDING OPERATIONS, PRODUCTION, AND RELATED CAPABILITY DEVELOPMENT
    - IN SINGLE MISSION INCREMENTS, INDICATE COST TO PLAN AND FLY 1 MISSION PER YEAR UP THROUGH 12 MISSIONS PER YEAR
    - AT EACH STEP, DETERMINE WHAT A 1 TIME ONLY INCREMENT OF 1 FLIGHT WOULD COST; ALSO A 1 TIME DECREMENT OF 1 FLIGHT
  - OSF RESOURCES MANAGEMENT TO CONCUR ON FINAL REPORT OR SUBMIT AN INDEPENDENT REPORT DETAILING AREAS OF NON-CONCURRENCE
  - BRIEFING EARLY JUNE, FINAL REPORT 2 WEEKS LATER

# **ZERO BASED OPERATIONS COST STUDY**

## **COMMON GROUND RULES AND ASSUMPTIONS**

- **DID NOT REVIEW IN DETAIL PROJECTS WITH EXPENDITURES BELOW \$10M/YEAR. PROJECTS REVIEWED REPRESENT APPROXIMATELY 98% OF TOTAL OPERATIONS COSTS**
- **THE PROGRAM CONTENT IN THE PRODUCTION BUDGET WILL CONTINUE AT ALL FLIGHT RATES WITH NO CHANGES**
- **AT LOW FLIGHT RATES WHEN FACILITIES OR VEHICLES ARE NOT NEEDED TO SUPPORT THE FLIGHT RATE, THEY ARE NOT MAINTAINED**
- **NO COST INCLUDED FOR RETENTION OF CAPABILITY TO INCREASE FLIGHT RATE AT A LATER DATE**
- **NO OMDP'S PERFORMED ON ORBITER VEHICLES NOT REQUIRED TO MEET THE STEADY STATE FLIGHT RATE**
- **NO CANNIBALIZATION OF VEHICLES FOR SPARES**
- **FLIGHTS ARE EVENLY SPACED AT ALL FLIGHT RATES, ESPECIALLY VERY LOW FLIGHT RATES**
- **FOR 1-6 FLIGHTS PER YEAR, ASSUME 1 OI RELEASE PER YEAR. FOR 7-10, ASSUME AN OI RELEASE EVERY 8 MONTHS (CURRENT RATE).**
- **MINIMUM BASE FOR ASTRONAUT CORPS IS 40 ASTRONAUTS (20 T-38 PILOTS AND 16 CMDR/PILOT ASSIGNMENTS). MINIMUM BASE SUPPORTS 1-3 FLIGHTS.**
- **ASSUME ALL SAFETY, DOCUMENTATION, FRR REQUIREMENTS REMAIN "BUSINESS AS USUAL"**
- **FOR EACH FLIGHT RATE CASE, THAT FLIGHT RATE IS THE ASSUMED STEADY STATE FLIGHT RATE FOR ALL FUTURE YEARS**

# ZERO BASE OPERATIONS COST STUDY

## GENERAL CATEGORIES

### FLIGHT HARDWARE BUILD & PROCESSING

ET, SRM, SRB - HARDWARE BUILDUP COSTS

ORBITER AND SSME - LOGISTICS/SPARES, ET DISCONNECTS, FEPC, RMS  
PROPELLANTS

LAUNCH PROCESSING AND PAYLOAD PROCESSING

CREW EQUIPMENT

### GROUND FACILITY M&O

SPC M&O - OPF, VAB, LCC, MLP, PAD, ET/SRB STACKING

STSOC M&O - MCC, SMS, SAIL, FDCF, MAIL

ET FACILITY M&O - MICHoud, SLIDELL

HOSC

JSC MOCKUPS AND TRAINERS - WETF, P/L MOCKUPS

JSC MEDICAL LABORATORIES

### FLIGHT HARDWARE SUST ENG

FLIGHT SUPPORT ANALYSIS AND ANOMALY RESOLUTION - ALL PROJECTS

ORBITER SUSTAINING ENGINEERING (EXCEPT FOR BACKUP FLIGHT SOFTWARE)

LAUNCH SUPPORT SERVICES - ALL PROJECTS

JSC ENGINEERING DIRECTORATE (EXCEPT FOR FLIGHT DATA SYSTEMS, I.E. IBM  
PRIME)

SHUTTLE PROGRAM OFFICE ENGINEERING INTEGRATION AND PAYLOAD  
INTEGRATION

### MISSION TRAINING & OPERATIONS

DIRECT SUPPORT TO MISSION OPERATIONS DIVISIONS (LOE)

FCOD - AIRCRAFT M&O, ASTRONAUT SUPPORT

### FLIGHT SOFTWARE

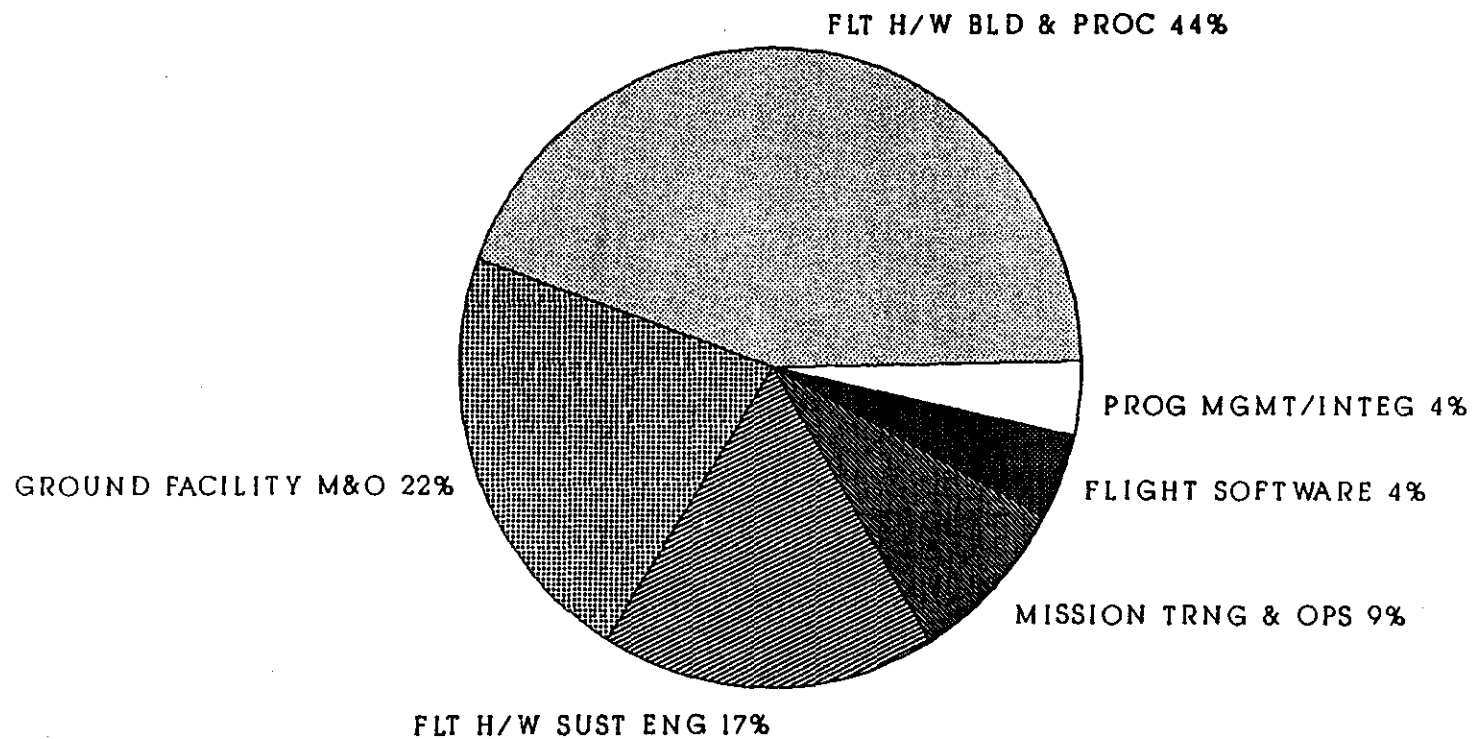
IBM PRIME, ORBITER BFS, SDF, SPF

### PROGRAM MGMT & INTEGRATION

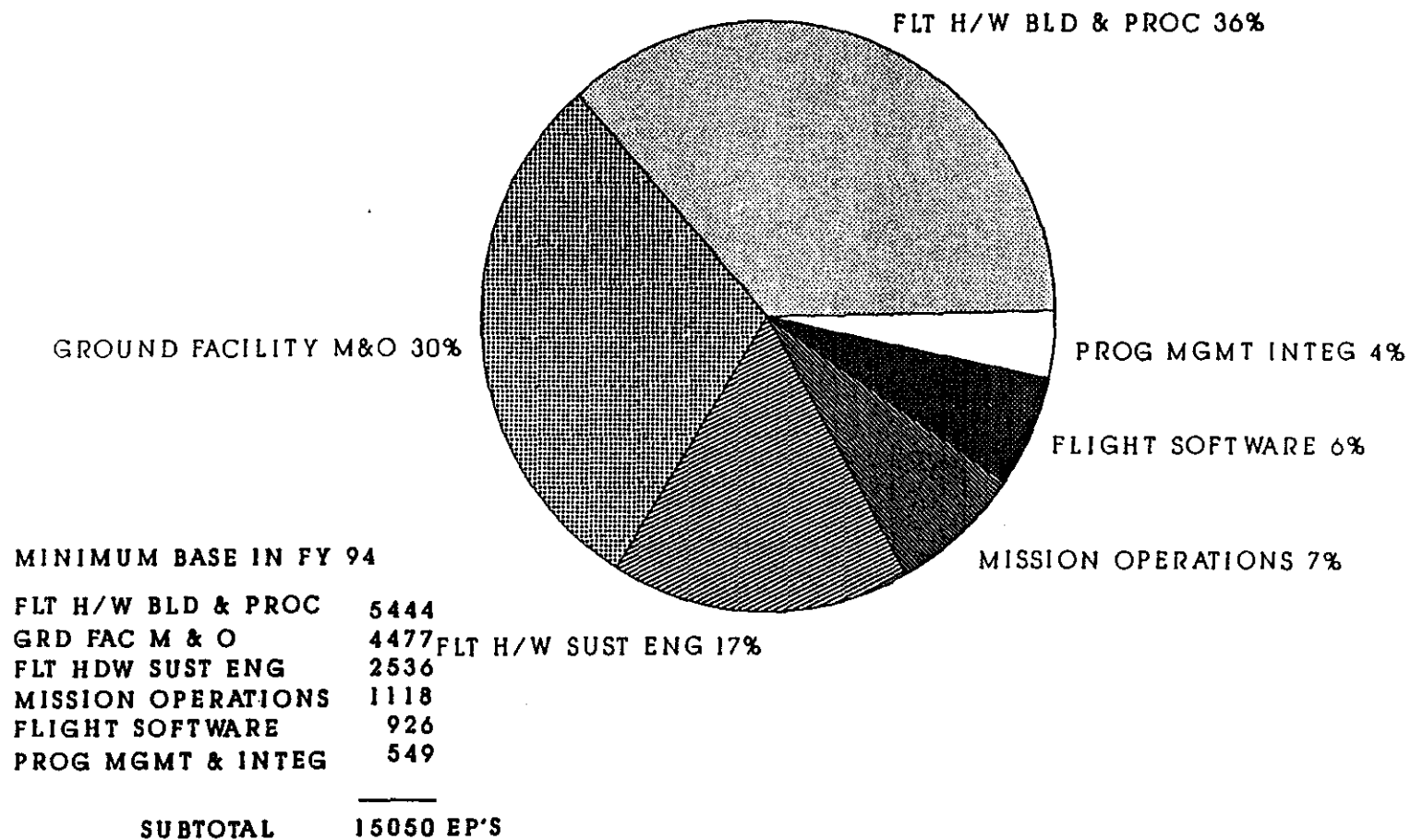
SSPO MGMT INTEGRATION, MSFC SYSTEMS

# ZERO BASE OPERATIONS COST STUDY

## ONE FLIGHT BASE COST - FY94

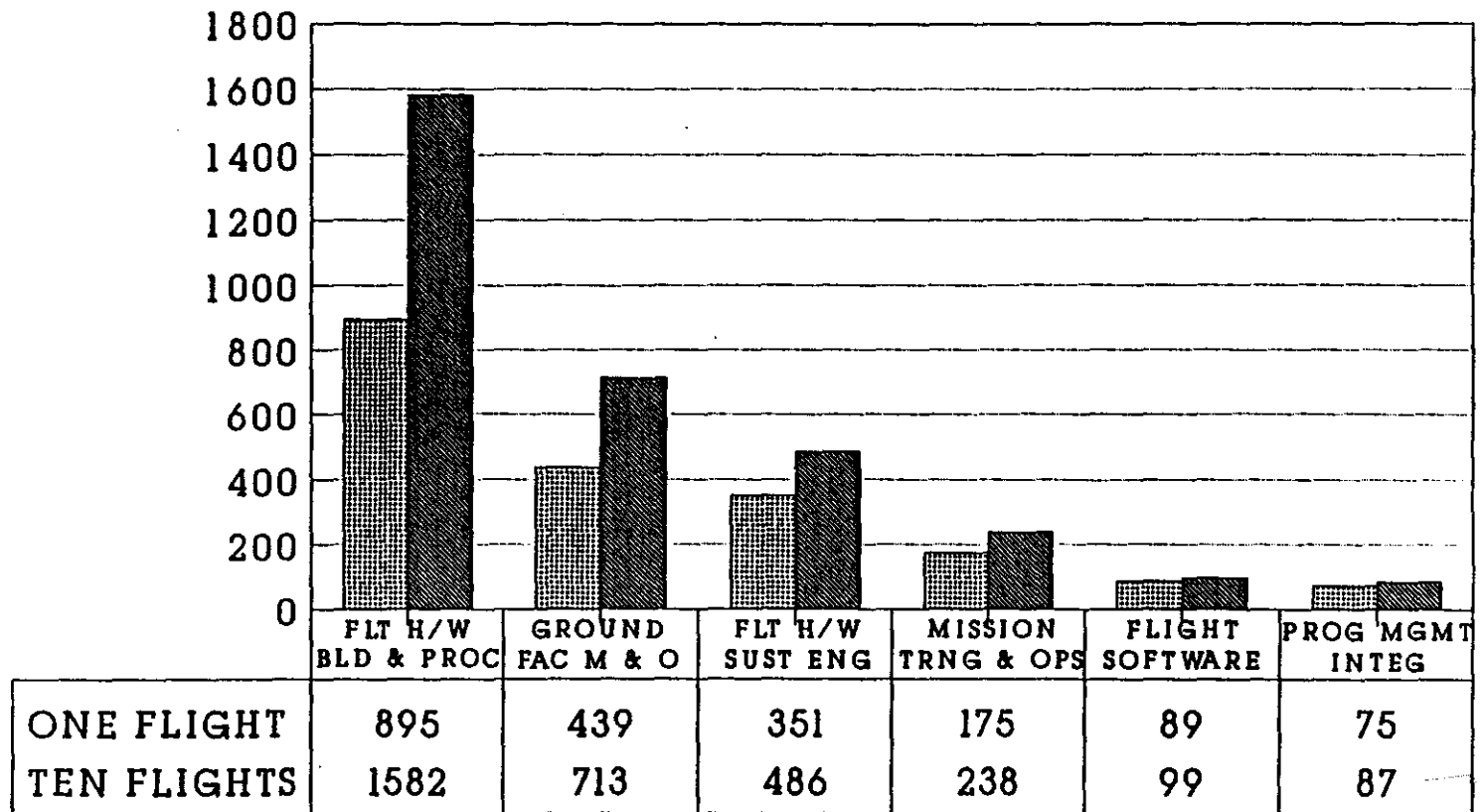


# ZERO BASE OPERATIONS COST STUDY ONE FLIGHT BASE MANPOWER - FY94



# ZERO BASE OPERATIONS COST STUDY

## BASE COST - FY 94



$\frac{1}{10}$   
 $= 63\%$



# ZERO BASE OPERATIONS COST STUDY

## ALL PROJECTS

### PERCENT INCREASE OVER BASE -- FY 94 IN RY \$

| PROJECT                          | FLIGHT RATE (\$) |       |       |       |       |       |       |       |       |       |
|----------------------------------|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                  | 1                | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |
| LAUNCH OPERATIONS                | 100.0            | 108.0 | 115.1 | 150.4 | 160.7 | 169.4 | 199.7 | 211.8 | 216.2 | 220.3 |
| EXTERNAL TANK                    | 100.0            | 100.0 | 100.0 | 100.0 | 104.2 | 108.6 | 113.3 | 118.3 | 122.6 | 126.7 |
| REDESIGNED SOLID ROCKET MOTOR    | 100.0            | 100.0 | 106.5 | 113.5 | 126.1 | 135.2 | 146.4 | 155.5 | 162.4 | 169.4 |
| MISSION OPERATIONS               | 100.0            | 104.1 | 107.6 | 110.2 | 115.4 | 119.3 | 125.5 | 128.7 | 131.6 | 133.8 |
| ORBITER                          | 100.0            | 101.9 | 104.7 | 116.6 | 122.7 | 126.5 | 136.2 | 139.0 | 142.6 | 144.6 |
| SHUTTLE LOGISTICS                | 100.0            | 105.4 | 112.1 | 119.6 | 125.4 | 134.8 | 148.3 | 159.2 | 170.2 | 175.1 |
| SOLID ROCKET BOOSTER             | 100.0            | 102.7 | 111.4 | 119.5 | 129.2 | 135.8 | 148.1 | 155.5 | 165.8 | 174.1 |
| SPACE SHUTTLE MAIN ENGINE        | 100.0            | 100.0 | 100.0 | 117.2 | 122.9 | 128.7 | 137.7 | 143.3 | 151.0 | 156.7 |
| SPACE SHUTTLE PROGRAM OFFICE     | 100.0            | 101.2 | 103.6 | 107.7 | 112.8 | 118.9 | 123.9 | 128.7 | 133.5 | 137.8 |
| OTHER                            |                  |       |       |       |       |       |       |       |       |       |
| - ENGINEERING                    | 100.0            | 100.4 | 101.7 | 104.3 | 110.0 | 114.0 | 115.0 | 118.5 | 119.8 | 120.7 |
| - FLIGHT CREW OPERATIONS         | 100.0            | 100.0 | 100.0 | 112.7 | 112.7 | 119.6 | 121.2 | 139.6 | 139.6 | 139.6 |
| - PAYLOAD OPERATIONS             | 100.0            | 100.7 | 177.5 | 210.6 | 226.8 | 269.0 | 273.9 | 278.9 | 297.9 | 305.6 |
| - PROPULSION SYSTEMS INTEGRATION | 100.0            | 103.2 | 104.8 | 111.7 | 111.7 | 115.3 | 119.4 | 119.4 | 119.4 | 119.4 |
| - SPACE AND LIFE SCIENCES        | 100.0            | 110.7 | 110.7 | 110.7 | 110.7 | 121.4 | 122.5 | 122.5 | 122.5 | 129.4 |

# ZERO BASE OPERATIONS COST STUDY

## ALL PROJECTS

### SHUTTLE OPERATIONS COSTS -- FY 94 IN RY \$

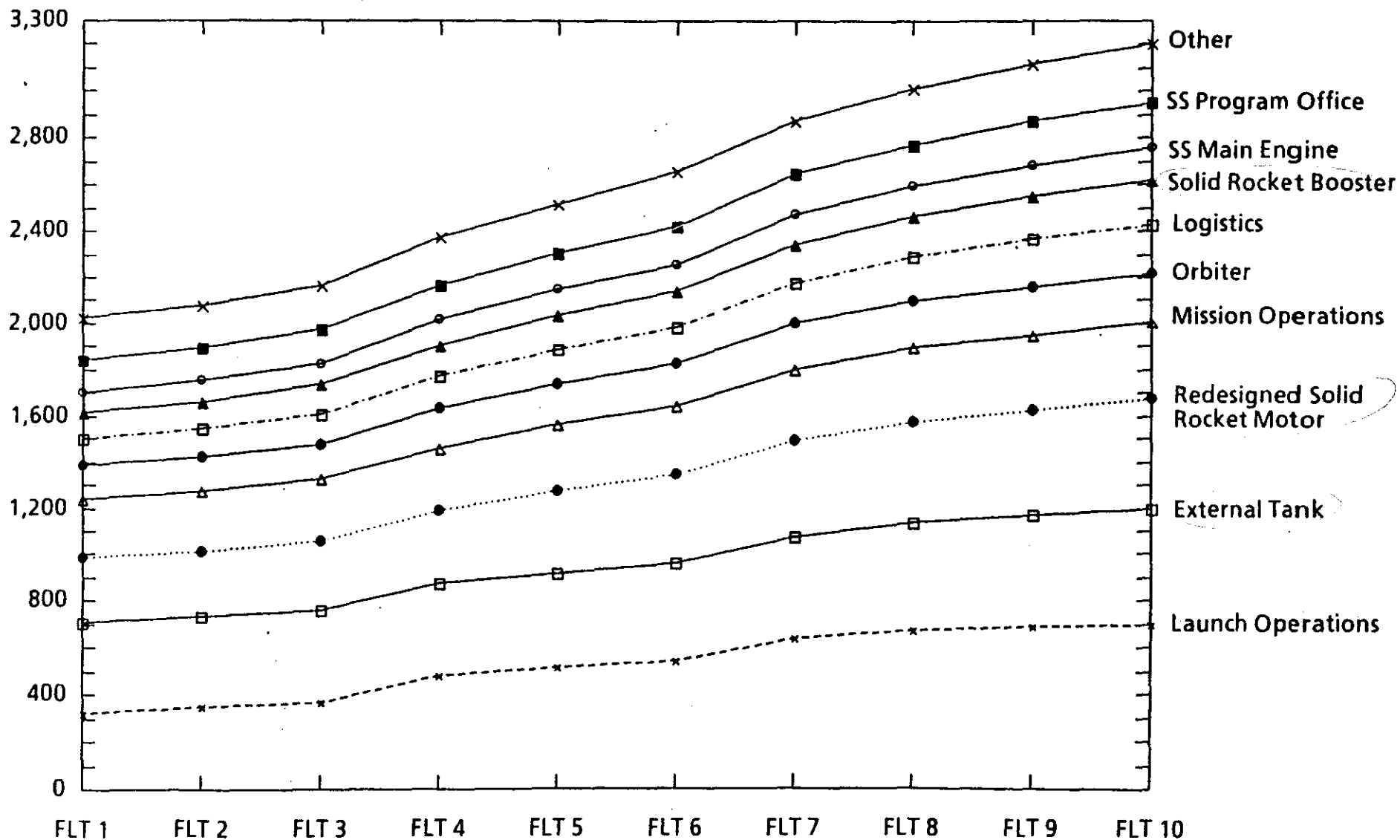
| PROJECT                          | From<br>WBS 94 | FLIGHT RATE (\$) |       |       |       |         |       |       |         |       |       |
|----------------------------------|----------------|------------------|-------|-------|-------|---------|-------|-------|---------|-------|-------|
|                                  |                | 1                | 2     | 3     | 4     | 5       | 6     | 7     | 8       | 9     | 10    |
| LAUNCH OPERATIONS                | ✓ 619.9        | 318.9            | 344.5 | 367.1 | 479.6 | 512.5   | 540.3 | 636.8 | 675.5   | 689.5 | 702.4 |
| EXTERNAL TANK                    | ✓ 372.4        | 389.3            | 389.3 | 389.3 | 389.3 | 405.5   | 422.6 | 441.0 | 460.6   | 477.1 | 493.2 |
| REDESIGNED SOLID ROCKET MOTOR    | ✓ 101.2        | (281.2)          | 281.2 | 299.5 | 319.1 | (354.7) | 380.1 | 411.7 | (437.3) | 456.8 | 476.3 |
| MISSION OPERATIONS               | ✓ 217.6        | 249.1            | 259.2 | 268.0 | 274.4 | 287.5   | 297.2 | 312.5 | 320.6   | 327.9 | 333.4 |
| ORBITER                          | ✓ 177.3        | 145.2            | 148.0 | 152.0 | 169.3 | 178.2   | 183.7 | 197.7 | 201.9   | 207.0 | 210.0 |
| LOGISTICS                        | ✓ 174          | 119.5            | 126.0 | 133.9 | 142.9 | 149.9   | 161.1 | 177.2 | 190.2   | 203.4 | 209.3 |
| SOLID ROCKET BOOSTER             | ✓ 152          | (111.0)          | 114.0 | 123.7 | 132.6 | (143.4) | 150.7 | 164.4 | (172.6) | 184.0 | 193.2 |
| SPACE SHUTTLE MAIN ENGINE        | ✓ 125.3        | 91.6             | 91.6  | 91.6  | 107.4 | 112.6   | 117.9 | 126.1 | (131.3) | 138.3 | 143.5 |
| SPACE SHUTTLE PROGRAM OFFICE     | ✓ 155          | 140.3            | 142.0 | 145.4 | 151.1 | 158.2   | 166.8 | 173.9 | 180.6   | 187.3 | 193.4 |
| OTHER                            |                |                  |       |       |       |         |       |       |         |       |       |
| - ENGINEERING                    | ✓ 128.4        | 76.9             | 77.2  | 78.2  | 80.2  | 84.6    | 87.7  | 88.4  | 91.1    | 92.1  | 92.8  |
| - FLIGHT CREW OPERATIONS         | ✓ 40           | 43.4             | 43.4  | 43.4  | 48.9  | 48.9    | 51.9  | 52.6  | 60.6    | 60.6  | 60.6  |
| - PAYLOAD OPERATIONS             | ✓ 36.7         | 14.2             | 14.3  | 25.2  | 29.9  | 32.2    | 38.2  | 38.9  | 39.6    | 42.3  | 43.4  |
| - PROPULSION SYSTEMS INTEGRATION |                | 24.8             | 25.6  | 26.0  | 27.7  | 27.7    | 28.6  | 29.6  | 29.6    | 29.6  | 29.6  |
| - SPACE AND LIFE SCIENCES        |                | 18.7             | 20.7  | 20.7  | 20.7  | 20.7    | 22.7  | 22.9  | 22.9    | 22.9  | 24.2  |

TOTAL FOR PROJECTS REVIEWED

2024.1 2077.0 2164.0 2373.1 2516.6 2649.5 2873.7 3014.4 3118.8 3205.3

# SPACE SHUTTLE PROGRAM ZERO BASE OPERATIONS COST STUDY SHUTTLE OPERATIONS COSTS -- FY94 IN RY \$

(RY \$ IN BILLIONS)



# **EXTERNAL TANK ZERO BASE OPERATIONS COST STUDY**

**ZERO BASE OPERATIONS COST STUDY  
EXTERNAL TANK  
GROUND RULES AND ASSUMPTIONS**

- INCREMENTS FOR ANALYSES ARE BASED UPON MINIMUM SKILLS, WORK STATION SHIFTING REQUIREMENTS, AND MAXIMUM FLIGHT RATE
- TOUCH LABOR INCREMENTS BASED UPON MINIMUM SKILL LEVELS AND AVERAGE UNIT VALUES DEVELOPED FROM AN 84% LEARNING CURVE
- ZERO BASE COST INCREMENTS WILL NOT EQUATE TO THE POP 91-1 SUBMIT DUE TO COSTS BEING BASED UPON STEADY-STATE CONDITIONS WHICH EXCLUDE BUILDUPS TO SUPPORT RAMP RATE INCREASES, COST REDUCTION INITIATIVES, AND CONSIDERATIONS FOR CURRENT INVENTORIES

27-Jun-91

# ZERO BASE OPERATIONS COST STUDY

## MSFC - EXTERNAL TANK

### SHUTTLE OPERATIONS COSTS BY ELEMENT -- FY 94 IN RY \$

| PROJECT | ELEMENT                      | FLIGHT RATE (\$) |       |       |       |       |       |       |       |       |       |
|---------|------------------------------|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|         |                              | 1                | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |
| ET      | BASIC PRODUCTION             | 249.4            | 249.4 | 249.4 | 249.4 | 265.4 | 282.4 | 300.7 | 320.2 | 336.6 | 352.6 |
| ET      | FLIGHT SUPPORT               | 18.4             | 18.4  | 18.4  | 18.4  | 18.4  | 18.4  | 18.4  | 18.4  | 18.4  | 18.4  |
| ET      | LOGISTICS                    | 2.3              | 2.3   | 2.3   | 2.3   | 2.5   | 2.6   | 2.7   | 2.8   | 2.9   | 3.0   |
| ET      | LAUNCH SUPPORT SERVICES      | 6.4              | 6.4   | 6.4   | 6.4   | 6.4   | 6.4   | 6.4   | 6.4   | 6.4   | 6.4   |
| ET      | TECHNICAL DIRECTIVES         | 9.6              | 9.6   | 9.6   | 9.6   | 9.6   | 9.6   | 9.6   | 9.6   | 9.6   | 9.6   |
| ET      | SLIDELL COMPUTER COMPLEX     | 11.2             | 11.2  | 11.2  | 11.2  | 11.2  | 11.2  | 11.2  | 11.2  | 11.2  | 11.2  |
| ET      | TE&A                         | 6.5              | 6.5   | 6.5   | 6.5   | 6.5   | 6.5   | 6.5   | 6.5   | 6.5   | 6.5   |
| ET      | FACILITIES                   |                  |       |       |       |       |       |       |       |       |       |
| ET      | - FACILITIES SELF-SUSTAINING | 49.7             | 49.7  | 49.7  | 49.7  | 49.7  | 49.7  | 49.7  | 49.7  | 49.7  | 49.7  |
| ET      | - PLANT OPERATIONS           | 31.7             | 31.7  | 31.7  | 31.7  | 31.7  | 31.7  | 31.7  | 31.7  | 31.7  | 31.7  |
| ET      | - MAF COMMUNICATIONS         | 4.1              | 4.1   | 4.1   | 4.1   | 4.1   | 4.1   | 4.1   | 4.1   | 4.1   | 4.1   |
|         |                              |                  |       |       |       |       |       |       |       |       |       |
|         |                              |                  |       |       |       |       |       |       |       |       |       |
|         |                              |                  |       |       |       |       |       |       |       |       |       |
|         |                              |                  |       |       |       |       |       |       |       |       |       |
|         |                              |                  |       |       |       |       |       |       |       |       |       |
|         | TOTAL                        | 389.3            | 389.3 | 389.3 | 389.3 | 405.5 | 422.6 | 441.0 | 460.6 | 477.1 | 493.2 |

**EXTERNAL TANK  
ZERO BASE OPERATIONS COST STUDY  
BASIC PRODUCTION  
FY94**

|                                    | <u>4/YEAR</u>       | <u>8/YEAR</u> | <u>10/YEAR</u> |
|------------------------------------|---------------------|---------------|----------------|
| <b>MARTIN MARIETTA LABOR</b>       |                     |               |                |
| TOUCH RELATED (All VARIABLE)       | \$ 45.8M<br>(496EP) | 67.6<br>(746) | 80.2<br>(888)  |
| EQUIV. UNIT RELATED                | \$ 59.2M<br>(641EP) | 72.3<br>(807) | 76.1<br>(856)  |
| TIME/TASK (All Fixed)              | \$ 64.3M<br>(697EP) | 64.3<br>(697) | 64.3<br>(697)  |
| <b>MATERIAL &amp; SUBCONTRACTS</b> |                     |               |                |
| VARIABLE                           | \$ 40.9M            | 73.3          | 88.1           |
| SEMI-FIXED                         | \$ 11.5M            | 13.4          | 13.8           |
| FIXED                              | \$ 20.5M            | 20.5          | 20.5           |
| <b>OTHER COSTS</b>                 | \$ <u>7.2M</u>      | <u>8.8</u>    | <u>9.6</u>     |
| <b>BASIC PRODUCTION</b>            | \$ 249.4M           | \$320.2M      | \$352.6M       |

**EXTERNAL TANK  
ZERO BASE OPERATIONS COST STUDY  
MANPOWER REQUIREMENTS  
(EQUIVALENT)**

| <u>BASIC PRODUCTION</u> |                          |                             |                  | <u>FIXED</u>                    |                           |  |   |              |
|-------------------------|--------------------------|-----------------------------|------------------|---------------------------------|---------------------------|--|---|--------------|
|                         | <u>TOUCH<br/>RELATED</u> | <u>EQ. UNIT<br/>RELATED</u> | <u>TIME/TASK</u> | <u>TECHNICAL<br/>DIRECTIVES</u> | <u>FLIGHT<br/>SUPPORT</u> | <u>LAUNCH<br/>SUPPORT<br/>SERVICES</u> | <u>FACILITIES<br/>SELF<br/>SUSTAINING</u> | <u>TOTAL</u> |
| ENGINEERING             |                          |                             |                  |                                 |                           |  |   |              |
| @4                      | 44                       | 23                          | 107              | 15                              | 116                       | 59                                     | ---                                       | 364          |
| @8                      | 51                       | 36                          | 107              | 15                              | 116                       | 59                                     | ---                                       | 384          |
| @10                     | 55                       | 41                          | 107              | 15                              | 116                       | 59                                     | ---                                       | 393          |
| TOOLING                 |                          |                             |                  |                                 |                           |  |   |              |
| @4                      | 33                       | 78                          | ---              | ---                             | ---                       | ---                                    | ---                                       | 111          |
| @8                      | 37                       | 91                          | ---              | ---                             | ---                       | ---                                    | ---                                       | 128          |
| @10                     | 39                       | 95                          | ---              | ---                             | ---                       | ---                                    | ---                                       | 134          |
| TOUCH                   |                          |                             |                  |                                 |                           |  |   |              |
| @4                      | 230                      | ---                         | ---              | ---                             | ---                       | ---                                    | ---                                       | 230          |
| @8                      | 404                      | ---                         | ---              | ---                             | ---                       | ---                                    | ---                                       | 404          |
| @10                     | 503                      | ---                         | ---              | ---                             | ---                       | ---                                    | ---                                       | 503          |
| MGF. SPT.               |                          |                             |                  |                                 |                           |  |   |              |
| @4                      | 106                      | 239                         | 99               | 29                              | 3                         | ---                                    | 4   | 480          |
| @8                      | 132                      | 317                         | 99               | 29                              | 3                         | ---                                    | 4   | 584          |
| @10                     | 143                      | 347                         | 99               | 29                              | 3                         | ---                                    | 4   | 625          |



# EXTERNAL TANK ZERO BASE OPERATIONS COST STUDY MMC LABOR TASKS

## BASIC PRODUCTION - SUPPORT DEPARTMENTS

| DEPARTMENT  | ESTIMATING BASIS   |  |   |
|-------------|--|--|---|
|             | TOUCH RELATED  | EQUIVALENT UNITS<br>RELATED  | TIME AND TASK<br>RELATED  |
| ENGINEERING | Conceptual Design Dev.<br>Prepare/Maintain System<br>Drawings, Support PDR'S &<br>CDR'S, Contractual Document-<br>ation, Compliance with I/F<br>definition | Liason support to Production<br>actions, Support MRB in<br>resolving anomalies, Maintain<br>FMEA/CIL, Maintain<br>acceptance test requirements                             | Engineering Administration,<br>Change processing, Special<br>projects, production<br>improvements, Scheduling<br>and estimating |
| TOOLING     | Design/Fab/Mod Replacement<br>Tools, Tool Maintenance &<br>Repair  | Administration/Planning/Sche-<br>duling of Tooling Replacement<br>and Tooling Maintenance &<br>Repair, Fabrication dies, jigs,<br>fixtures, and other specialized<br>tools |   |

# EXTERNAL TANK ZERO BASE OPERATIONS COST STUDY MMC LABOR TASKS

## BASIC PRODUCTION - SUPPORT DEPARTMENTS

| DEPARTMENT                   | ESTIMATING BASIS  |  |  |
|------------------------------|---|--|--|
|                              | TOUCH RELATED   | EQUIVALENT UNITS<br>RELATED  | TIME AND TASK<br>RELATED   |
| MANUFACTURING<br>SUPPORT     | Supervise and train "Build" employees in Structures, TPS and Final Assy, Supervise and train Production Engineers | Industrial/Production Engineering, Production Control, Work Order Setup, Transportation and Handling, MAR's support, floor support to resolve problems | Estimating Change Control, Industrial Mgmt., Methods and Standards, Production Improvements, Master Plans and Scheduling                                       |
| INSPECTION                   | Recurring Inspection of ET Hardware and Tooling Maintenance   | Recurring inspection of Tool Maintenance   |  |
| QUALITY ASSURANCE<br>SUPPORT | Inspection Supervision, Manufacturing Handling Plan compliance on Critical Hardware moves                         | Production Floor Quality Compliance, Vendor Surveillance, Process Control Development, Receiving & Shipping, Non-destructive testing and evaluation    | Quality Administration, Procedures Development, Records Retention, ADP Development and Support, Production Improvements, Maintain dept. and company procedures |

**EXTERNAL TANK  
ZERO BASE OPERATIONS COST STUDY  
MANPOWER REQUIREMENTS  
(EQUIVALENT)**

| <u>BASIC PRODUCTION</u>  |                             |                  |                                 | <u>FIXED</u>              |  |   |     | <u>TOTAL</u> |
|--------------------------|-----------------------------|------------------|---------------------------------|---------------------------|--|---|-----|--------------|
| <u>TOUCH<br/>RELATED</u> | <u>EQ. UNIT<br/>RELATED</u> | <u>TIME/TASK</u> | <u>TECHNICAL<br/>DIRECTIVES</u> | <u>FLIGHT<br/>SUPPORT</u> | <u>LAUNCH<br/>SUPPORT<br/>SERVICES</u> | <u>FACILITIES<br/>SELF<br/>SUSTAINING</u> |     |              |
| INSPECTION               |                             |                  |                                 |                           |  |   |     |              |
| @4                       | 60                          | 5                | ---                             | ---                       | ---                                    | ---                                       | --- | 65           |
| @8                       | 88                          | 6                | ---                             | ---                       | ---                                    | ---                                       | --- | 94           |
| @10                      | 109                         | 6                | ---                             | ---                       | ---                                    | ---                                       | --- | 115          |
| QUALITY SUPPORT          |                             |                  |                                 |                           |  |   |     |              |
| @4                       | 23                          | 149              | 41                              | 13                        | 19                                     | ---                                       | 6   | 251          |
| @8                       | 34                          | 176              | 41                              | 13                        | 19                                     | ---                                       | 6   | 289          |
| @10                      | 39                          | 186              | 41                              | 13                        | 19                                     | ---                                       | 6   | 304          |
| PERF. ENHANCEMENT        |                             |                  |                                 |                           |  |   |     |              |
| @4                       | ---                         | ---              | 18                              | 2                         | ---                                    | ---                                       | --- | 20           |
| @8                       | ---                         | ---              | 18                              | 2                         | ---                                    | ---                                       | --- | 20           |
| @10                      | ---                         | ---              | 18                              | 2                         | ---                                    | ---                                       | --- | 20           |
| MATERIAL                 |                             |                  |                                 |                           |  |   |     |              |
| @4                       | ---                         | 4                | 31                              | ---                       | ---                                    | ---                                       | 1   | 36           |
| @8                       | ---                         | 8                | 31                              | ---                       | ---                                    | ---                                       | 1   | 40           |
| @10                      | ---                         | 8                | 31                              | ---                       | ---                                    | ---                                       | 1   | 40           |

**EXTERNAL TANK  
ZERO BASE OPERATIONS COST STUDY  
MANPOWER REQUIREMENTS  
(EQUIVALENT)**

|                 | <u>BASIC PRODUCTION</u>  |                             |                  | <u>FIXED</u>                    |                           |  |   | <u>TOTAL</u> |
|-----------------|--------------------------|-----------------------------|------------------|---------------------------------|---------------------------|--|---|--------------|
|                 | <u>TOUCH<br/>RELATED</u> | <u>EQ. UNIT<br/>RELATED</u> | <u>TIME/TASK</u> | <u>TECHNICAL<br/>DIRECTIVES</u> | <u>FLIGHT<br/>SUPPORT</u> | <u>LAUNCH<br/>SUPPORT<br/>SERVICES</u> | <u>FACILITIES<br/>SELF<br/>SUSTAINING</u> |              |
| CONTRACTS       |                          |                             |                  |                                 |                           |  |   |              |
| @4              | ---                      | ---                         | 20               | ---                             | 17                        | ---                                    | 2   | 39           |
| @8              | ---                      | ---                         | 20               | ---                             | 17                        | ---                                    | 2   | 39           |
| @10             | ---                      | ---                         | 20               | ---                             | 17                        | ---                                    | 2   | 39           |
| FINANCE         |                          |                             |                  |                                 |                           |  |   |              |
| @4              | ---                      | ---                         | 27               | ---                             | 1                         | ---                                    | 1   | 29           |
| @8              | ---                      | ---                         | 27               | ---                             | 1                         | ---                                    | 1   | 29           |
| @10             | ---                      | ---                         | 27               | ---                             | 1                         | ---                                    | 1   | 29           |
| PLANNING        |                          |                             |                  |                                 |                           |  |   |              |
| @4              | ---                      | ---                         | 22               | 6                               | 4                         | ---                                    | ---                                       | 32           |
| @8              | ---                      | ---                         | 22               | 6                               | 4                         | ---                                    | ---                                       | 32           |
| @10             | ---                      | ---                         | 22               | 6                               | 4                         | ---                                    | ---                                       | 32           |
| HUMAN RESOURCES |                          |                             |                  |                                 |                           |  |   |              |
| @4              | ---                      | ---                         | 17               | ---                             | ---                       | ---                                    | 19  | 36           |
| @8              | ---                      | 1                           | 17               | ---                             | ---                       | ---                                    | 19  | 37           |
| @10             | ---                      | 1                           | 17               | ---                             | ---                       | ---                                    | 19  | 37           |

**EXTERNAL TANK  
ZERO BASE OPERATIONS COST STUDY  
MANPOWER REQUIREMENTS  
(EQUIVALENT)**

|            | <u>BASIC PRODUCTION</u>  |                             |                  | <u>FIXED</u>                    |                           |  |   | <u>TOTAL</u> |
|------------|--------------------------|-----------------------------|------------------|---------------------------------|---------------------------|--|---|--------------|
|            | <u>TOUCH<br/>RELATED</u> | <u>EQ. UNIT<br/>RELATED</u> | <u>TIME/TASK</u> | <u>TECHNICAL<br/>DIRECTIVES</u> | <u>FLIGHT<br/>SUPPORT</u> | <u>LAUNCH<br/>SUPPORT<br/>SERVICES</u> | <u>FACILITIES<br/>SELF<br/>SUSTAINING</u> |              |
| MIS        |                          |                             |                  |                                 |                           |  |   |              |
| @4         | ---                      | ---                         | 138              | ---                             | 17                        | ---                                    | 1   | 156          |
| @8         | ---                      | ---                         | 138              | ---                             | 17                        | ---                                    | 1   | 156          |
| @10        | ---                      | ---                         | 138              | ---                             | 17                        | ---                                    | 1   | 156          |
| SECURITY   |                          |                             |                  |                                 |                           |  |   |              |
| @4         | ---                      | ---                         | ---              | ---                             | ---                       | ---                                    | 105                                       | 105          |
| @8         | ---                      | ---                         | ---              | ---                             | ---                       | ---                                    | 105                                       | 105          |
| @10        | ---                      | ---                         | ---              | ---                             | ---                       | ---                                    | 105                                       | 105          |
| FACILITIES |                          |                             |                  |                                 |                           |  |   |              |
| @4         | ---                      | 143                         | 177              | ---                             | ---                       | ---                                    | 297                                       | 617          |
| @8         | ---                      | 172                         | 177              | ---                             | ---                       | ---                                    | 297                                       | 646          |
| @10        | ---                      | 172                         | 177              | ---                             | ---                       | ---                                    | 297                                       | 646          |
| TOTAL      |                          |                             |                  |                                 |                           |  |   |              |
| @4         | 496                      | 641                         | 697              | 65                              | 177                       | 59                                     | 436                                       | 2571         |
| @8         | 746                      | 807                         | 697              | 65                              | 177                       | 59                                     | 436                                       | 2987         |
| @10        | 888                      | 856                         | 697              | 65                              | 177                       | 59                                     | 436                                       | 3178         |

**EXTERNAL TANK  
ZERO BASE OPERATIONS COST STUDY  
MMC LABOR TASKS**

**BASIC PRODUCTION - SUPPORT DEPARTMENTS**

| <b>DEPARTMENT</b> | <b>ESTIMATING BASIS</b> |   |  |
|-------------------|-------------------------|---|--|
|                   | <b>TOUCH RELATED</b>    | <b>EQUIVALENT UNITS<br/>RELATED</b>   | <b>TIME AND TASK<br/>RELATED</b>   |
| <b>FACILITIES</b> |                         | Facilities Planning, Facilities Administration, Help Desk, Crib (storage), Plant Maintenance, Facilities Operations, Critical Systems Maintenance, Waste Disposal | Environmental Engineering, Equipment Engineering, R&A Craft, R&A Engineering, Maintenance Engineering, General Maintenance, IWTF Maintenance, Computer Support |

# EXTERNAL TANK ZERO BASE COST STUDY BASIC PRODUCTION

## MATERIAL AND SUBCONTRACTS - VARIABLE COST

- EACH INCREMENT BASED UPON AN FY91 STEADY STATE ENVIRONMENT
- STEADY STATE ENVIRONMENT IMPLIES NO GAPPING TO VENDORS
  - A CONTINUED 4/YR DELIVERY RATE COULD IMPACT EFFICIENCY AT VENDORS IF MSS IS A SIGNIFICANT PERCENT OF SUPPLIER BASE
- THE AVERAGE COST OF A FLIGHT HARDWARE SHIPSET IS \$9.3M (BURDENED)

|        | FY94\$<br>BURDENED<br><u>TOTAL</u> | <u>AVG.</u> |
|--------|------------------------------------|-------------|
| @ 4/YR | \$40.9M                            | \$10.2M     |
| @ 8/YR | \$73.3M                            | \$9.2M      |
| @10/YR | \$88.1M                            | \$8.8M      |

- FLIGHT HARDWARE SHIPSET COST IMPROVEMENTS
  - 73% OF THE FLIGHT-BILL-OF-MATERIALS WAS RECOMPETED BETWEEN 4TH AND 5TH BUYS RESULTING IN COST BENEFITS:

|         | <u>FY91\$</u> |
|---------|---------------|
| 4TH BUY | \$8.9M        |
| 5TH BUY | 6.0           |

EXTERNAL TANK  
 ZERO BASE OPERATIONS COST STUDY  
 BASIC PRODUCTION  
 MATERIAL AND SUBCONTRACTS - SEMI-FIXED  
 (\$ IN MILLIONS)\*

|   |                          | FY94           |                |                 |
|---|--------------------------|----------------|----------------|-----------------|
|   |                          | <u>@4/YEAR</u> | <u>@8/YEAR</u> | <u>@10/YEAR</u> |
| ● | PRODUCTION OPERATIONS    |                |                |                 |
| ● | TOOLING MAINTENANCE      | 7.8            | 8.5            | 8.6             |
| ● | TEST PANELS              | <u>.1</u>      | <u>.3</u>      | <u>.5</u>       |
|   | TOTAL                    | 7.9            | 8.8            | 9.1             |
| ● | FACILITIES               |                |                |                 |
| ● | MAINTENANCE AND SUPPLIES | 2.8            | 3.2            | 3.2             |
| ● | WASTE DISPOSAL           | <u>.8</u>      | <u>1.4</u>     | <u>1.5</u>      |
|   | TOTAL                    | 3.6            | 4.6            | 4.7             |
| ● | TOTAL                    | 11.5           | 13.4           | 13.8            |

\* BURDENED



**EXTERNAL TANK  
ZERO BASE COST STUDY  
BASIC PRODUCTION  
MATERIAL & SUBCONTRACTS - FIXED**

- **ENGINEERING**
  - **FAILURE ANALYSIS ACTIVITIES IN ENGINEERING LABS**
  - **SUPPORT QUALIFICATION OF NEW VENDORS**
  - **PRODUCTION TESTING - TPS SAMPLES**
  - **SUPPORT SPECIAL ENGINEERING PROJECTS**
  - **SUPPORT MFG. PROCESS IMPROVEMENTS**
- **PRODUCTION OPERATIONS**
  - **SUPPORT MFG. PROCESS IMPROVEMENTS**
- **PRODUCT ASSURANCE**
  - **SUBCONTRACT EFFORT FOR VALIDATING MANUFACTURING AND INSPECTION PROCESS**
  - **WITNESSING FABRICATION**
  - **CALIBRATION OF TESTING EQUIPMENT**
  - **QUALITY LAB SUPPLIES**
- **FACILITIES**
  - **MANUFACTURING AREA JANITORIAL AND R&A**
  - **ADPE MAINTENANCE AND SUPPLIES**
  - **AIR AND GROUNDWATER LAB ANALYSIS**
- **OTHER**
  - **SOFTWARE MAINTENANCE AND SUPPLIES**
  - **PERSONNEL TRAINING AND SUPPLIES**

**EXTERNAL TANK**  
**ZERO BASE OPERATIONS COST STUDY**  
**BASIC PRODUCTION**  
**MATERIAL & SUBCONTRACTS - FIXED**  
 (\$ IN MILLIONS)\*

|                     | FY94           |                |                 |
|---------------------|----------------|----------------|-----------------|
|                     | <u>@4/YEAR</u> | <u>@8/YEAR</u> | <u>@10/YEAR</u> |
| • ENGINEERING       | 2.7            | 2.7            | 2.7             |
| • PRODUCTION        | .7             | .7             | .7              |
| • PRODUCT ASSURANCE | .8             | .8             | .8              |
| • FACILITIES        | 16.0           | 16.0           | 16.0            |
| • OTHER             | <u>.3</u>      | <u>.3</u>      | <u>.3</u>       |
| <br>TOTAL           | <br>20.5       | <br>20.5       | <br>20.5        |

\* BURDENED

# EXTERNAL TANK ZERO BASE OPERATIONS COST STUDY FY94

|                                      | <u>4/YEAR</u>       | <u>8/YEAR</u> | <u>10/YEAR</u> |
|--------------------------------------|---------------------|---------------|----------------|
| FLIGHT SUPPORT - FIXED COSTS         |                     |               |                |
| MCC LABOR                            | \$ 18.4M<br>(177EP) | 18.4<br>(177) | 18.4<br>(177)  |
| LOGISTICS                            |                     |               |                |
| MATERIAL AND SUBCONTRACTS            |                     |               |                |
| VARIABLE - BARGE MOVEMENT            | \$ .4M              | .9            | 1.1            |
| FIXED - BARGE OVERHAUL               | \$ <u>1.9M</u>      | <u>1.9</u>    | <u>1.9</u>     |
| TOTAL LOGISTICS                      | \$ 2.3M             | 2.8           | 3.0            |
| LAUNCH SUPPORT SERVICES              |                     |               |                |
| MMC LABOR                            | \$ 6.4M<br>(59EP)   | 6.4<br>(59)   | 6.4<br>(59)    |
| TECHNICAL DIRECTIVES                 |                     |               |                |
| MMC LABOR                            | \$ 6.4M<br>(65EP)   | 6.4<br>(65)   | 6.4<br>(65)    |
| MATERIAL AND SUBCONTRACTORS          | \$ <u>3.2M</u>      | <u>3.2</u>    | <u>3.2</u>     |
| TOTAL TECHNICAL DIRECTIVES           | \$ 9.6M             | 9.6           | 9.6            |
| SLIDELL COMPUTING COMPLEX OPERATIONS | \$ 11.2M            | 11.2          | 11.2           |
| TE&A (STE, I&PS, RI, SM&QA)          | \$ 6.5M             | 6.5           | 6.5            |

**EXTERNAL TANK  
ZERO BASE OPERATIONS COST STUDY  
FACILITIES RELATED TASKS  
FY94**

|                                  | <u>4/YEAR</u>       | <u>8/YEAR</u> | <u>10/YEAR</u> |
|----------------------------------|---------------------|---------------|----------------|
| FACILITIES SELF-SUSTAINING       |                     |               |                |
| MCC LABOR                        | \$ 33.8M<br>(436EP) | 33.8<br>(436) | 33.8<br>(436)  |
| MATERIAL AND SUBCONTRACTS        | \$ <u>15.9M</u>     | <u>15.9</u>   | <u>15.9</u>    |
| TOTAL FACILITIES SELF-SUSTAINING | \$ 49.7M            | 49.7          | 49.7           |
| PLANT OPERATIONS                 | \$ 31.7M            | 31.7          | 31.7           |
| MAF COMMUNICATIONS               | \$ <u>4.1M</u>      | <u>4.1</u>    | <u>4.1</u>     |
| TOTAL FACILITIES RELATED         | \$ 85.5M            | 85.5          | 85.5           |

**EXTERA TANK**  
**ZERO BASE OPERATIONS COST STUDY**  
**MANPOWER REQUIREMENTS**  
**(EQUIVALENT)**

| <u>BASIC PRODUCTION</u> |                          |                             |                  | <u>FIXED</u>                    |                           |  |   |              |
|-------------------------|--------------------------|-----------------------------|------------------|---------------------------------|---------------------------|--|---|--------------|
|                         | <u>TOUCH<br/>RELATED</u> | <u>EQ. UNIT<br/>RELATED</u> | <u>TIME/TASK</u> | <u>TECHNICAL<br/>DIRECTIVES</u> | <u>FLIGHT<br/>SUPPORT</u> | <u>LAUNCH<br/>SUPPORT<br/>SERVICES</u> | <u>FACILITIES<br/>SELF<br/>SUSTAINING</u> | <u>TOTAL</u> |
| MIS                     |                          |                             |                  |                                 |                           |  |   |              |
| @4                      | ---                      | ---                         | 138              | ---                             | 17                        | ---                                    | 1   | 156          |
| @8                      | ---                      | ---                         | 138              | ---                             | 17                        | ---                                    | 1   | 156          |
| @10                     | ---                      | ---                         | 138              | ---                             | 17                        | ---                                    | 1   | 156          |
| SECURITY                |                          |                             |                  |                                 |                           |  |   |              |
| @4                      | ---                      | ---                         | ---              | ---                             | ---                       | ---                                    | 105                                       | 105          |
| @8                      | ---                      | ---                         | ---              | ---                             | ---                       | ---                                    | 105                                       | 105          |
| @10                     | ---                      | ---                         | ---              | ---                             | ---                       | ---                                    | 105                                       | 105          |
| FACILITIES              |                          |                             |                  |                                 |                           |  |   |              |
| @4                      | ---                      | 143                         | 177              | ---                             | ---                       | ---                                    | 297                                       | 617          |
| @8                      | ---                      | 172                         | 177              | ---                             | ---                       | ---                                    | 297                                       | 646          |
| @10                     | ---                      | 172                         | 177              | ---                             | ---                       | ---                                    | 297                                       | 646          |
| TOTAL                   |                          |                             |                  |                                 |                           |  |   |              |
| @4                      | 496                      | 641                         | 697              | 65                              | 177                       | 59                                     | 436                                       | 2571         |
| @8                      | 746                      | 807                         | 697              | 65                              | 177                       | 59                                     | 436                                       | 2987         |
| @10                     | 888                      | 856                         | 697              | 65                              | 177                       | 59                                     | 436                                       | 3178         |

Richard COTA

AC

Comptroller's  
Office

# **ZERO BASE OPERATIONS COST STUDY RSRM PROJECT**

**ZERO BASE OPERATIONS COST STUDY  
MSFC SPACE SHUTTLE  
RSRM PROJECT  
GENERAL GROUNDRULES/ASSUMPTIONS**

- **BASIS OF ESTIMATE IS POP 91-1 OPERATIONS DATA BASE**
- **ASSUMES CONSTANT LAUNCH RATES (2/YR - 10/YR) FOR FY91 - FY97 BUDGET**
- **SEVERANCE PAY/TRAINING FOR LAYOFFS/RAMP-UPS HAVE NOT BEEN INCLUDED**
- **THE IMPACT OF RSRME IMPLEMENTATION, QUALIFICATION, AND SAVINGS ARE EXCLUDED**
- **ASSUMES NO SHUTDOWN OF VENDORS OR FACILITIES**
- **ASSUMES ONE FSM STATIC TEST PER YEAR**
- **ASSUMES BUYOUT OF AP SURCHARGE AND AT 6 FLIGHTS PER YEAR, ASSUME ONLY 1 SUPPLIER OF AP REQUIRED**
- **LABOR RATES AND OVERHEADS WERE ADJUSTED FOR FLIGHT RATE IMPLICATIONS**

28-Jun-91

# ZERO BASE OPERATIONS COST STUDY

## MSFC - REDESIGNED SOLID ROCKET MOTOR

### SHUTTLE OPERATIONS COSTS BY ELEMENT -- FY 94 IN RY \$

| PROJECT | ELEMENT                | FLIGHT RATE |       |       |       |       |       |       |       |       |       |
|---------|------------------------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|         |                        | 1           | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |
| RSRM    | MANUFACTURING          | 94.6        | 94.6  | 98.2  | 102.6 | 114.9 | 119.4 | 124.3 | 130.3 | 135.7 | 142.1 |
| RSRM    | ENGINEERING/MGMT/OTHER | 43.6        | 43.6  | 44.1  | 44.6  | 47.2  | 49.1  | 50.2  | 52.1  | 52.1  | 52.5  |
| RSRM    | SR&QA                  | 36.7        | 36.7  | 38.1  | 40.6  | 42.8  | 46.6  | 49.9  | 54.3  | 54.2  | 54.1  |
| RSRM    | AMMONIUM PERCHLORATE   | 7.7         | 7.7   | 11.1  | 14.2  | 16.9  | 19.5  | 32.2  | 36.6  | 41.0  | 45.4  |
| RSRM    | OTHER MATERIALS        | 14.2        | 14.2  | 19.5  | 24.2  | 31.8  | 39.3  | 44.6  | 48.2  | 52.9  | 57.5  |
| RSRM    | SUBCONTRACTS           | 7.4         | 7.4   | 8.3   | 9.2   | 10.8  | 12.2  | 13.3  | 14.8  | 17.9  | 19.0  |
| RSRM    | ODC                    | 11.9        | 11.9  | 12.6  | 13.4  | 14.9  | 15.8  | 17.0  | 18.2  | 19.0  | 19.8  |
| RSRM    | G&A & FEE              | 65.1        | 65.1  | 67.6  | 70.3  | 75.4  | 78.2  | 80.2  | 82.8  | 84.0  | 85.9  |
|         |                        |             |       |       |       |       |       |       |       |       |       |
|         |                        |             |       |       |       |       |       |       |       |       |       |
|         |                        |             |       |       |       |       |       |       |       |       |       |
|         |                        |             |       |       |       |       |       |       |       |       |       |
|         |                        |             |       |       |       |       |       |       |       |       |       |
|         |                        |             |       |       |       |       |       |       |       |       |       |
|         |                        |             |       |       |       |       |       |       |       |       |       |
|         |                        |             |       |       |       |       |       |       |       |       |       |
|         |                        |             |       |       |       |       |       |       |       |       |       |
|         |                        |             |       |       |       |       |       |       |       |       |       |
|         | TOTAL                  | 281.2       | 281.2 | 299.5 | 319.1 | 354.7 | 380.1 | 411.7 | 437.3 | 456.8 | 476.3 |



**MSFC**  
**ZERO BASE OPERATIONS COST STUDY**  
**RSRM PROJECT**  
**MAJOR DRIVERS TO THE MINIMUM BASE**

**FLIGHTS/YEAR**

**BASE (2 FLIGHTS)**

**RATIONALE**

- **MANUFACTURING - ASSUMES PRESENT WORK CENTER STRUCTURE, WORKSTATION CAPACITY, AND SKILL LEVELS REQUIRED TO ACCOMPLISH EACH OPERATION**
- **ENGINEERING/MGMT/OTHER - CRITICAL SKILLS RETENTION**
- **SR&QA - ASSUMES WORK CENTER STRUCTURE AND WORKSTATION CAPACITY**
- **AMMONIUM PERCHLORATE - MINIMUM BUY FROM KERR-MCGEE IS 2 SHIPSETS OF MATERIAL. ASSUME WECCO IS SHUT DOWN.**
- **OTHER MATERIALS AND SUBCONTRACTS - PRICED REQUIRED QUANTITIES, ADJUSTED UP FOR REDUCED QUANTITIES**
- **ODC - INDIVIDUAL ESTIMATES, I.E., LEASES = SAME AS POP 91-1, TRAVEL/ COMPUTER FUNCTION OF MANPOWER**
- **OVERRIDING DRIVERS - 2 PER YEAR BASE PRIMARILY DRIVEN BY CORPORATE RECOMMENDATION. COST EFFECTIVENESS IMPLIES BASE OF APPROXIMATELY 4 FLIGHTS/YEAR.**

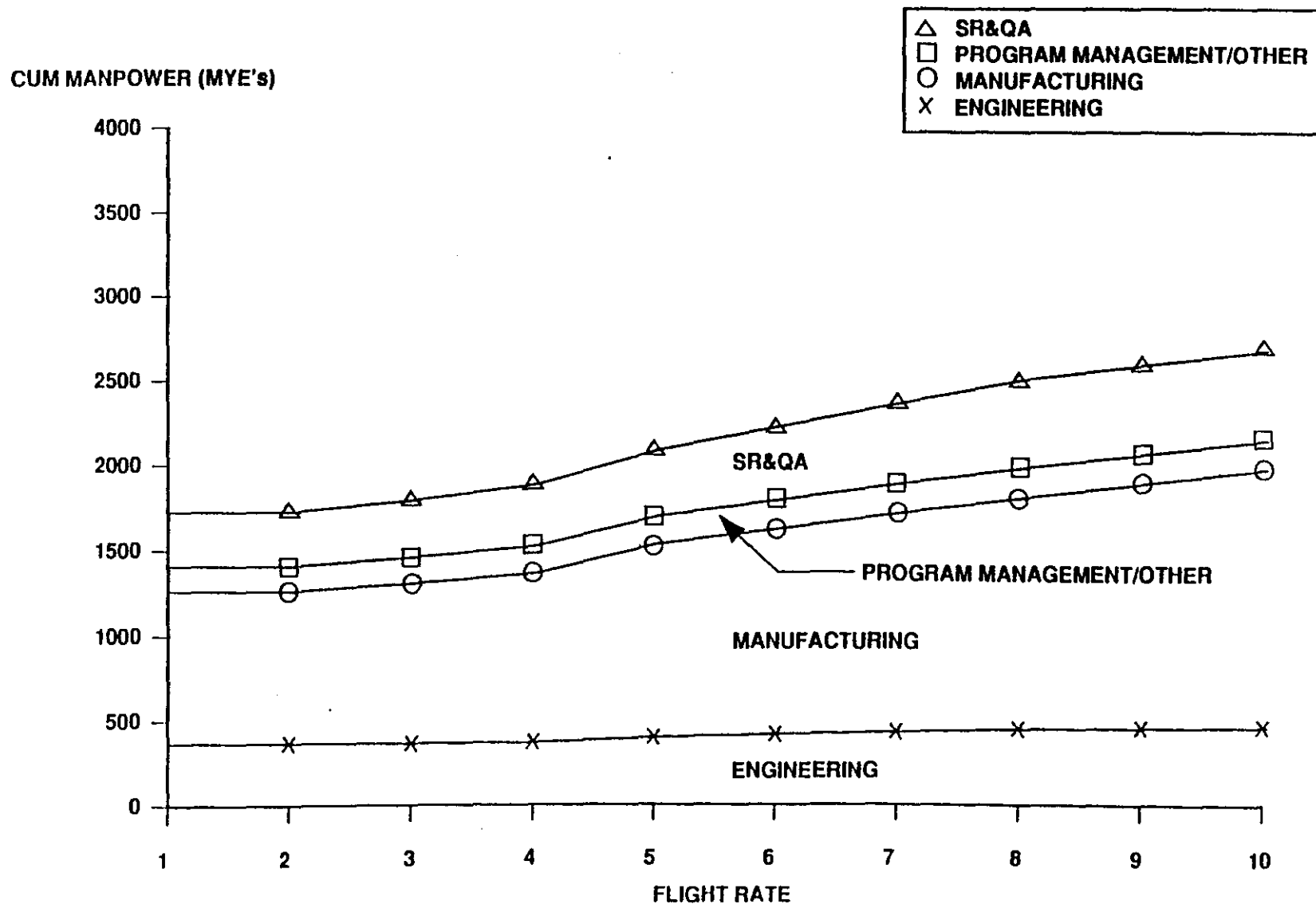
MS. C  
**ZERO BASE OPERATIONS COST STUDY**  
**RSRM PROJECT**  
**MAJOR DRIVERS TO FLIGHT RATE BASE AND INCREMENTS**

| <u>FLIGHTS/YEAR</u> | <u>RATIONALE</u>   |
|---------------------|--|
| 2 (BASE)            |  |
| 3                   | ● MANUFACTURING SUPPORT AND TOUCH LABOR; 1 FLT SET MATERIAL  |
| 4                   | ● MANUFACTURING SUPPORT AND TOUCH LABOR; 1 FLT SET MATERIAL  |
| 5                   | ● MANUFACTURING SUPPORT AND TOUCH LABOR; 1 FLT SET MATERIAL  |
| 6                   | ● MANUFACTURING/SR&QA TOUCH LABOR; 1 FLT SET MATERIAL  |
| 7                   | ● MANUFACTURING/SR&QA TOUCH LABOR; 1 FLT SET MATERIAL<br>ADD WECCO AS SECOND SOURCE FOR AMMONIUM PERCHLORATE |
| 8                   | ● MANUFACTURING SR&QA TOUCH LABOR; 1 FLT SET MATERIAL  |
| 9                   | ● MANUFACTURING TOUCH LABOR; 1 FLT SET MATERIAL  |
| 10                  | ● MANUFACTURING TOUCH LABOR; 1 FLT SET MATERIAL  |

# MSFC SPACE SHUTTLE RSRM PROJECT ZERO BASE OPERATIONS COST STUDY

JULY 2, 1991

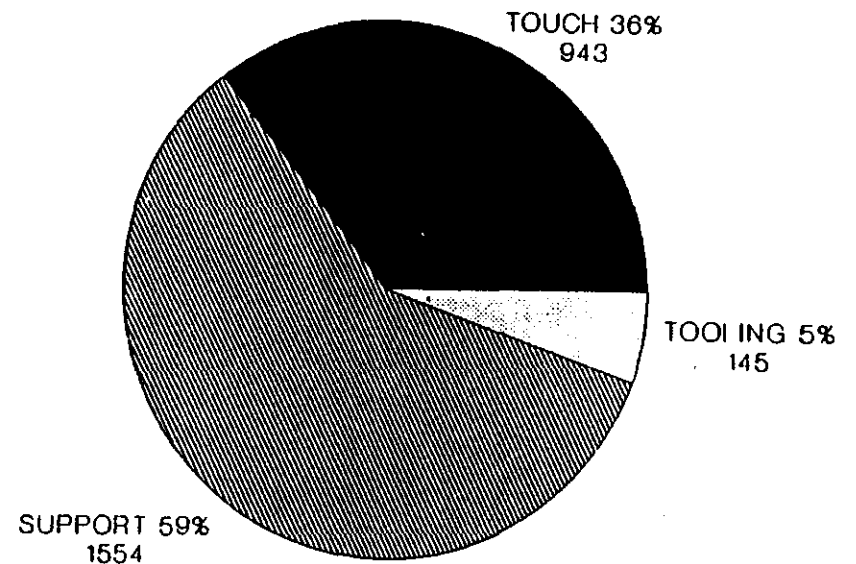
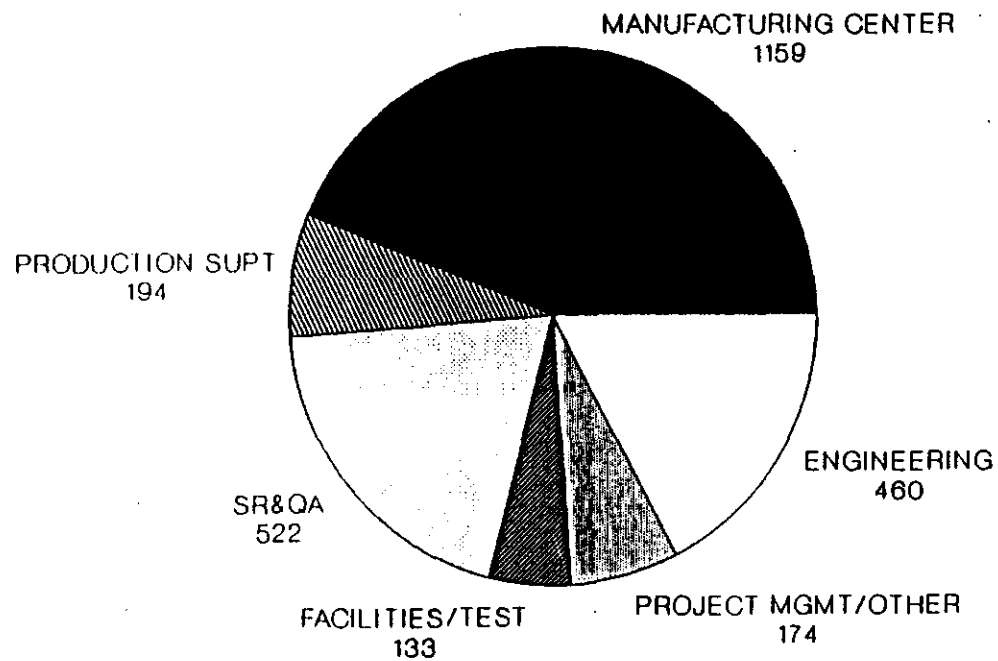
## MANPOWER SUMMARY BY FUNCTION - FY94



# RSRM PROGRAM

## ZERO BASED OPERATIONS COST STUDY

### TOTAL LABOR -- FY94



10 FLIGHTS/YEAR  
2642

**ZERO BASE OPERATIONS COST STUDY  
MSFC SPACE SHUTTLE  
RSRM PROJECT  
MANUFACTURING AND SR&QA  
TOUCH AND SUPPORT MANPOWER - METRICS**

**TOUCH**

- EVALUATED ALL OPERATIONS REQUIRED TO BUILD AND REFURBISH 1 FLIGHT SET OF ALL HARDWARE BASED ON CURRENT RSRM MANUFACTURING STANDARDS AND DEMONSTRATED SRM/RSRM 86% LEARNING CURVE AS INITIAL BASIS OF ESTIMATE
  - ALL DISASSEMBLY AND MANUFACTURING OPERATIONS
  - LOGISTICS AND TRANSPORTATION
  - MANUFACTURING INSPECTION AND RECEIVING INSPECTION
- CONDUCTED A MICRO EVALUATION USING THE FOLLOWING:
  - WORKSTATION CAPACITY
  - MINIMUM NUMBER OF SHIFTS REQUIRED FOR EACH WORKSTATION
  - SKILL LEVEL TO ACCOMPLISH EACH OPERATION
  - MINIMUM NUMBER OF PERSONNEL REQUIRED FOR EACH SKILL LEVEL
  - MINIMUM NUMBER OF HOURS REQUIRED FOR EACH SKILL LEVEL
  - TRANSFER OF SKILLS AS POSSIBLE
  - MINIMUM NUMBER OF PERSONNEL AND UTILIZATION REQUIRED AT LAUNCH RATES  
1-4, 6, 8, 10

**SUPPORT**

- GRASSROOTS ESTIMATE WAS ESTABLISHED FOR EACH WORK CENTER FOR 4 AND 10 LAUNCH RATES

JUNE 11, 1991

**MSFC SPACE SHUTTLE  
RSRM PROJECT  
ZERO BASE OPERATIONS COST STUDY**

**ENGINEERING MANPOWER - METRICS**

- **INITIAL BASIS OF ESTIMATE**
  - **CURRENT HISTORY**
  - **HISTORY FACTORED INTO THREE GROUPS**
    - **FABRICATION SUPPORT**
    - **FLIGHT SUPPORT**
    - **FSM STATIC TEST SUPPORT**
- **ESTIMATE ESTABLISHED BY APPLYING UNIT HISTORY FACTORS TO PROJECT CONTENT**
  - **ESTIMATE LIMITED BY CRITICAL SKILLS RETENTION REQUIREMENT**

JUN 11 '91 9:11 FROM RSRM PROJECT OFFICE TO JSC-PK-CIL PHGE.013

**ZERO BASE OPERATIONS COST STUDY  
MSFC SPACE SHUTTLE  
RSRM PROJECT  
MATERIALS - METRICS**

- PER FLIGHT QUANTITIES BASED ON POP 91-1.
- ASSUMES POP 91-1 UNIT COST, ADJUSTED UP FOR REDUCED QUANTITIES; NO VENDORS WERE CONTACTED
- SPECIAL CONSIDERATIONS, MINIMUM REQUIREMENTS
  - RAYON YARN WAS PRICED AT 25,000 POUNDS/WEEK UNTIL MODEL REQUIREMENT MET; THEN VENDOR SHUT DOWN.
  - AMMONIUM PERCHLORATE WAS PRICED WITH KERR MCGEE AS THE SOLE SUPPLIER FROM 2-6 FLIGHTS PER YEAR. AT 7 FLIGHTS PER YEAR, ADEQUATE DEMAND EXISTS TO SUPPORT BOTH KERR MCGEE AND WECCO, AND BOTH SUPPLIERS ARE USED ABOVE THAT RATE.